Best Copy Available

F2

(11) (CA) No. 806,352

(45) ISSUED Feb. 18, 1969

(52) CLASS 2-1.12
C.R. CL. 15-70.9

(10) # CANADIAN PATENT

(54) SANITARY PRODUCT WITH CROSS-LINKED CELLULOSIC LAYER

Carole C. Van Haaften, Neenah, Wisconsin, U.S.A.

Granted to Kimberly-Clark Corporation, Neenah, Wisconsin, U.S.A.

(21) APPLICATION No. 922,172
(22) FILED Feb. 1, 1965

(30) PRIORITY DATE Apr. 7, 1964 (357,946) U.S.A.

No. OF CLAIMS 8

The present invention relates to disposable absorbent pads such as sanitary napkins, diapers, hospital pads and the like. More particularly, this invention relates to improvements in the construction of absorbent pads to provide more effective control of the flow of body fluids which strike the pad and are absorbed therein.

In absorbent pads, and especially sanitary napkins, it is highly desirable that the construction be such that any discharged body fluids which strike the surface thereof be carried to the interior of the pad as rapidly as possible to be distributed evenly throughout the interior absorbent portion and retained therein. If this is accomplished effectively, excessive spreading of the fluid on the pad surface is avoided with the result that undesirable surface staining is minimized, while the pad area which contacts the body remains substantially dry, thus promoting a sense of comfort and security for the user. While most sanitary napkins now on the market function satisfactorily in most respects, the problem of preventing excessive surface staining has not been successfully solved. One of the most common complaints received from users by manufacturers of sanitary napkins relates to soiled underclothing largely attributed to such staining. Apparently, if the body fluid has spread over the pad surface because of slow absorption in the pad, or as the result of heavy flow, it also spreads to the clothing; if the fluid spread on the pad surface is minimal, the clothing is not affected.

Accordingly, it is a major object of this invention to provide an absorbent pad in which the spreading of fluids on the surface is minimized.

Another object is to provide sanitary napkins with a component which acts as an effective fluid transfer element to rapidly wick accepted body fluids away from the napkin surface to the interior of the napkin where it is evenly distributed and absorbed.

A further object is to provide a sanitary napkin in which fluid absorbed in the interior thereof is substantially prevented from migrating back to the exterior.

Other objects and advantages will become apparent from the following description and appended drawings, in which:

Fig. 1 is a perspective view of an absorbent bandage of the present invention taken from the bottom side, with a section of the pad cut away and the wrapper partially open.

Fig. 2 is a sectional view of the bandage shown in Fig. 1, but with the top and bottom in the normal positions as worn.

Fig. 3 is a view similar to Fig. 2 of an alternate construction.

Fig. 4 is a sectional view of another construction.

Fig. 5 is a sectional view of still another possible construction.

The above objects are attained by constructing an absorbent bandage in a manner to include a highly resilient fluffy layer or batt of specially modified fibers in close proximity to the usual pervious outer wrapper, with an internally disposed highly absorbent element in contiguous association therewith. The modified fibers which make up the resilient layer are internally cross-linked cellulosic fibers of a type hereinafter described. In one embodiment, the layer of cross-linked fibers is located only on the body side of the bandage overlying an absorbent core. In this position, the cross-linked fiber layer acts as an effective fluid transfer agent to rapidly wick accepted fluid down into juxtaposed layers on the interior of the bandage where it is absorbed, distributed, and held by underlying components.

In another embodiment, the layer of cross-linked fibers may extend around each side, and in contiguous association with an absorbent core. In this construction, that portion of the

layer which lies on the top of the core acts in the same way as described above. That portion which lies on either side of the core inhibits the fluid which has been absorbed in the interior from migrating outward, thus also preventing side stains. The resilient nature of the cross-linked fiber layer also adds to comfort by remaining dry and airy while providing additional cushioning.

In still another embodiment, the layer of cross-linked fibers may completely enclose an absorbent core. In this construction, the bandage may be worn with either side up. Fluid will strike through as previously described, but will be effectively trapped in the absorbent core within the layer, if the absorbent core is not super-saturated, which sometimes happens inadvertently when the bandage is worn too long.

As shown in the drawings, absorbent bandages, such as sanitary napkins, generally comprise an absorbent pad 10 wrapped in a pervious outer wrapper 11. In the embodiment shown in Figs. 1 and 2, the pad 10 comprises a fluid flow control element 12 comprising an assembly of cross-linked cellulose fibers, a multiple layer of absorbent cellulose wadding 13, a layer of absorbent cellulosic fluff 14 wrapped in an optional sheath of creped wadding 16, and a fluid impervious baffle 15, which may consist of thin plastic such as polyethylene or the like. The entire combination is held in unitary assembly by an outer pervious covering 11 which may comprise gauze, non-woven threads, non-woven fabric, or the like.

In an alternate embodiment, shown in Fig. 3, the pad assembly comprises the cross-linked fiber element 12, a layer of absorbent fluff 14 wrapped in an optional sheet of creped wadding 16 and a fluid impervious baffle 15.

In other embodiments, as shown in Figs. 4 and 5, the element 12 comprising cross-linked fibers may extend from the top of the absorbent core down along each side thereof (Fig. 4) or even completely around the core (Fig. 5).

Other suitable assemblies of absorbent elements may also be used. However, in each case, it is necessary that the element located immediately under the top or body side of the wrapper comprise cross-linked cellulose fibers as identified by the number 12 in the drawing. For various mechanical or functional reasons, very thin fluid-pervious sheets or apertured material may be interposed between the cross-linked element and the wrapper, but in any event, such materials should be of a type which do not inhibit fluid transfer from the surface of the pad to the interior.

The cross-linked cellulosic fibers which comprise element 12 are assembled in the form of a loose fluffy mass. Such a mass has a low resistance to fluid flow, yet exhibits a high capacity for fluid retention in interstitial spaces between fibers, without material physical distortion of the fiber mass, even in a wetted condition. The exterior of the fibers is easily wetted as the fluid is drawn into the element, but virtually no interior absorption or swelling occurs within the individual fibers. It has been found that an element comprising a loose, fluffy mass of the cross-linked fibers tends to give up fluids normally retained therein to a contiguously associated, more compact, absorbent fibrous element having finer capillary spaces between fibers.

The cross-linked fibers employed in this invention are characterized by an internal cross-linking, particularly ether linkages between molecules of the cellulose. Such fibers are obtained by first impregnating cellulose in fiber form with an aqueous solution containing a cross-linking agent and a catalyst. The moist mass of fibers is then expanded into a loose, fluffy condition and while in such loose condition is dried without effecting substantial cross-linking. The dried fluffy mass is then subjected to an increased temperature which is sufficiently high to cause a cross-linking reaction to take place while

maintaining the mass in its loose, fluffy condition. The reacted fibers are subsequently washed, to remove unreacted constituents, and dried.

The particulars of the cross-linking treatment are set forth in detail in Canadian Patent 729,513 issued March 8, 1966. As described in that application, the cellulosic fibers which may be used include any of the wood pulp fibers used in papermaking, hemp fibers, short cotton fibers, alpha cellulose, cotton linters, short-cut regenerated cellulose fibers, and the like. Wood pulp fibers are generally preferred. The preferred cross-linking agents are formaldehyde or dimethylol urea, but other known cross-linking agents and suitable catalysts may be used. A particularly effective catalyst is aluminum sulfate. The impregnation is effected while the fibers are expanded or swollen, thus insuring entry of the cross-linking agent and catalyst in quantity to the fiber interior. After impregnation, the fibers are dried and collapsed in which condition the cross-linking reaction is carried out.

The temperature for the cross-linking reaction is dependent to some extent upon the nature of the cellulosic fiber used; for wood pulp fibers the preferred range is between 110°-165°C. The resulting fibers retain the natural shape of the original fibers, but in their modified state are more rigid, even when wetted, and are less deformable under load, thus providing improved dimensional stability. The rigidity of the modified fibers, while not such as to render the fiber mass brittle, is such that the fibers will reduce to a powdered state rather than plasticize or hydrate when subjected to a refining or beating action, as usually employed in the papermaking art. For use as the flow control element of this invention, it is important that the cross-linked fibers be retained in their fibrous state rather than being broken up by refining or beating.

The cross-linked cellulosic material, while in the fibrous condition described above, is assembled in a loose batt or fluff form, and in this form exhibits an unusually high wet stiffness, high wet bulk and porosity, high wet resiliency, low dry density, and low wet compressibility, as compared to the same properties in a batt of non-cross-linked cellulose fibers. These batts also have a high wicking rate for aqueous and other polar fluids. By a high wicking rate it is meant that such fluids are transported rapidly through the batt by capillary forces.

It has been found that fibers cross-linked as above described have greater bulk and about twice the resistance to compression in the wet state as untreated pulps and at least 50% greater recovery after such compression. It is these properties, and the concomitant high wicking rate, which apparently provide the absorbent bandages of this invention with their unique advantages with respect to minimizing surface stains, when suitably combined with other more conventional absorbent elements.

The rate of wicking of fluids through fibrous batts made from cross-linked material as above described may be demonstrated in various ways. In one example, a flat transparent plate approximately 3"x3" was used to hold a $2\frac{1}{2}$"x$4\frac{1}{2}$" batt. The batt projected beyond one edge of the plate for approximately $1\frac{1}{2}$" into an aqueous dye solution maintained at a constant level. The time for the dye to wick completely through the batt to its opposite end was measured. For a fiber batt of cross-linked wood pulp fibers, wicking time was 20 seconds. For untreated fibers from the same source, wicking time was 49 seconds. Thus, the cross-linked fiber batt had a wicking rate approximately $2\frac{1}{2}$ times faster than a batt of untreated fibers.

The cross-linked fibers have been found to work most effectively in the form of a fluffy, loosely assembled component located immediately below the bandage wrapper on the side of the bandage which is in contact with the body. In this position, the cross-linked fluff component functions as an effective fluid transfer agent to rapidly wick the fluid down into contiguous

interiorly disposed absorbent elements to be evenly distributed therein. With the rapid wicking properties of the assembled fibers, one would normally expect the accepted fluids to spread transversely in the element as well. However, under the defined conditions, there is virtually no horizontal or transverse migration of fluid within the cross-linked fiber element when positioned contiguous to conventional absorbent material. This unexpected result effectively reduces the area of top stains, and is especially advantageous for sanitary napkins. The surface thus is maintained relatively dry and the napkin is more comfortable in use.

Resistance to side stains is also increased when the cross-linked fiber element is made wide enough to extend down from the surface area along each side of the absorbent inner elements. It has been found that, for some reason, the fluid which has been absorbed in the inner element does not migrate outwardly through the cross-linked fibers positioned along the sides with the result that side stains are also minimized.

It has been found further, that when the absorbent inner element is completely enwrapped by a cross-linked fiber element, fluids are effectively trapped within the inner element and will not migrate outwardly in any direction through the cross-linked fiber element.

The reason for this latter phenomenon, in view of the recognized rapid wicking properties of the cross-linked element, is not entirely understood. It is believed attributable to the fact that because the interstitial pore size of the absorbent inner elements is much smaller than the pore size of the cross-linked fiber element, the inner element has a stronger capillary attraction for the absorbed fluids. The interstitial pore size of the cross-linked element is relatively large and since the pore size is not reduced, even under wet compression, the fluids apparently tend to remain in the central element having the smaller pore size.

As noted above, in order for the cross-linked element to work most effectively, it is essential that the element be located in close proximity to the fluid pervious bandage wrapper, and between said wrapper and a contiguously placed lower or central absorbent material. Any type of conventionally used absorbent material, such as cellulose wadding, cotton fiber batts, wood fiber fluff and the like, may be employed as the inner absorbent elements of the pad. In the embodiments shown in Figs. 1 and 2, the other absorbent elements comprise multiple layers of cellulose wadding over a layer of wood fiber fluff and a bottom impervious baffle. In Figs. 3, 4, and 5, the absorbent layer consists entirely of wood fiber fluff. Various other combinations and arrangements of baffles and absorbent elements may also be used.

The amount of cross-linked fiber material used is not too critical, but should be adjusted in accordance with the flow rate expected. In a pad weighing a total of from about 10 to 14 grams, cross-linked fiber batts weighing from 0.5 to 4.0 grams per 16 square inches have been used. In each instance, surface stains were reduced when compared with pads which had no cross-linked element present. The thickness of the cross-linked element is preferably sufficient to at least partially mask the dark color of the body fluid absorbed in the interior of the pad. For such purposes, a thickness of 1/16" has been found satisfactory. For super-size pads, which are designed for women with extra heavy flow, much thicker cross-linked elements may be employed.

While the preferred embodiments of the invention have been shown and described herein, it will be appreciated that the details may be more or less modified without departing from the principles and scope of the invention as defined in the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An absorbent bandage comprising a fluid absorbent pad, a fluid pervious outer wrapper, and, between the fluid absorbent pad and the outer wrapper, a layer of fibers in mass form, said fibrous mass comprising a loose assembly of cross-linked cellulosic fibers, said fibers being cross-linked while in the collapsed dry state to a degree wherein said fibers are not readily plasticized by contact with aqueous fluids, said fibrous mass being characterized by a larger pore size than the pore size of said absorbent pad and a capacity to rapidly wick fluids therethrough into contact with, and absorption by, said absorbent pad.

2. The absorbent bandage of Claim 1 in which the cross-linked fibers are wood pulp fibers.

3. In an absorbent bandage comprising multiple layers of absorbent material enwrapped in a fluid pervious wrapper, the improvement which comprises providing a batt-like layer of loosely assembled, cross-linked cellulose fibers between and in contiguous association with said absorbent material and said wrapper, said cross-linked fibers being cross-linked while in the collapsed dry state to a degree where they are not readily plasticized by contact with aqueous fluids, said layer of cross-linked fibers having a larger pore size than the pore size of said layers of absorbent material.

4. A sanitary napkin with improved resistance to top staining which comprises superposed layers of fluff-like cellulosic material enwrapped in a fluid pervious wrapper, the top layer of said material comprising a batt of loosely assembled, cross-linked cellulosic fibers, said fibers being cross-linked while in the

collapsed dry state to a degree where they are not readily plasticized when contacted with aqueous fluids, the remaining layers of said material comprising loosely assembled wood fluff, having a smaller pore size than the pore size of the cross-linked fiber batt.

5. A sanitary napkin comprising an elongate fluid receptive pad and a fluid permeable wrapper, said pad comprising multiple continuous layers of fibrous material, said multiple layers comprising a first layer of loosely assembled, cross-linked fibers in which the fibers are cross-linked while in the collapsed dry state to a degree where said fibers are not readily plasticized when contacted with aqueous fluids, a second layer of absorbent cellulose wadding sheets, a third layer of loosely assembled wood fiber fluff, and a bottom fluid impervious layer, said layer of cellulose wadding sheets and said layer of wood fiber fluff having a smaller pore size than the pore size of the layer of cross-linked fibers.

6. A sanitary napkin comprising an elongate absorbent pad and a fluid permeable wrapper, said pad comprising multiple layers of cellulosic material including a first layer of cross-linked cellulosic fibers wherein the cross-linking has been carried out while said fibers are in the collapsed dry state to a degree wherein said fibers are not readily plasticized when contacted with aqueous fluids, a second layer of cellulose fluff, and a bottom fluid impervious layer, said fluff layer having a smaller pore size than the pore size of the layer of cross-linked fibers.

7. A sanitary napkin according to Claim 6 in which the cross-linked layer extends down along either side of said second layer.

8. A sanitary napkin comprising an absorbent pad and a fluid permeable wrapper, said pad comprising a central absorbent core of untreated cellulosic material completely encircled by a layer of cross-linked cellulosic fibers, said fibers being cross-linked while in the collapsed dry state to a degree wherein said fibers are not readily plasticized when contacted with aqueous fluids, said cross-linked fiber layer having a larger pore size than the pore size of said absorbent core of untreated cellulosic material.

869352
2-2

Fig. 3

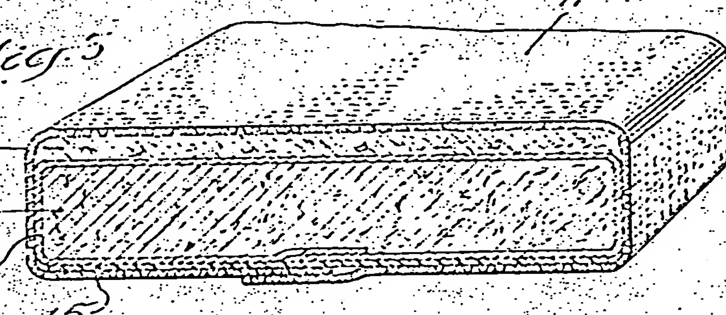


Fig. 4

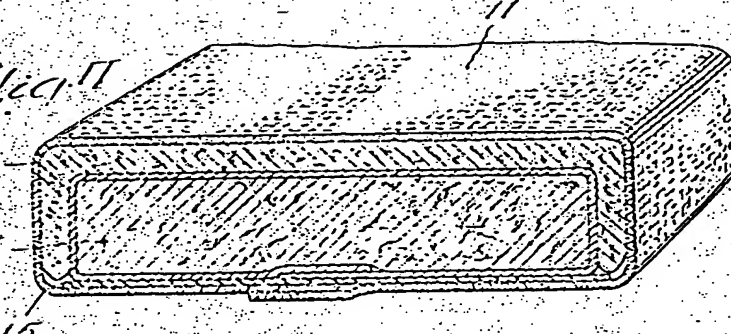
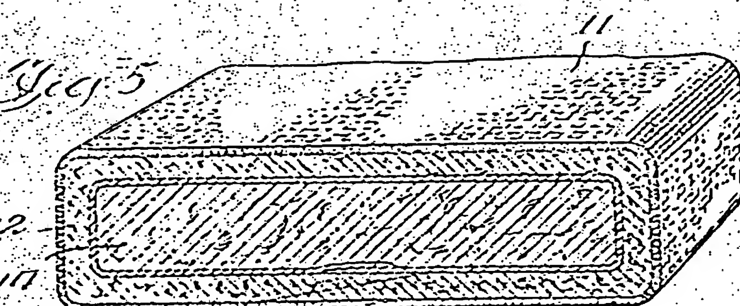


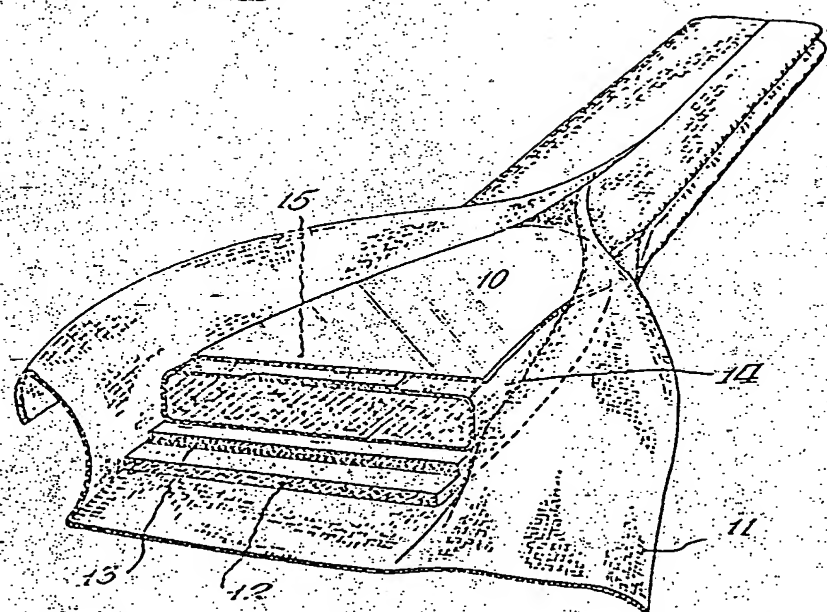
Fig. 5



806352

2-1

Fig-1



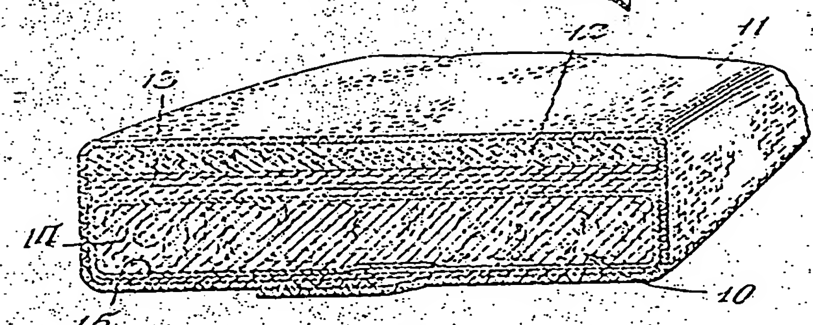


Fig-2